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ORIGINAL ESSAY H

O N

ANIMAL MOTION:

IN WHICH

THE INSTRUMENT THEREOF, ITS DE-
FINITION, AND MODE OF
OPERATING,

ARE MINUTELY TREATED UPON.

BY *** NEC CULLENIVS NEC BRUNONIUS.

Nullius addictus jurare in verba magistri.—
HOR.

PHILADELPHIA:

1792.

P R E F A C E .
For Dr Letson .

WHOSOEVER is acquainted in any
degree with medicine, cannot be
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Where is the theory in which, before
Henry Wilkins. The author.

propel in the annuity of
Pennsylvania
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Reason and experience are the tests of
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with the present

April 1793
Philadelphia
no 62. north Front Street.

P R E F A C E.

WHOEVER is acquainted in any degree with medicine, cannot be ignorant that the doctrine of animal motion is the basis upon which the structure of a true theory of phylic must be laid: and as every doctrine upon that subject, hitherto published, is both incomplete and inconceivable, the theory of phylic must be incomplete also.

Where is the theory, in which, before you have read one half of it, you have not reached a vacuum or what is of little more consequence?

At present, I believe, there are but three doctrines which divide the sentiments of American practitioners, and, no doubt, each of these have truths in them that will for ever remain: but, when we view either of them for complete systems, systems to extend ad infinitum in diseases (which a true theory would do) they fall far short.

Reason and experience are the tests of sound doctrine: let us see how they answer with the present.

In

In the humoral pathology we find diseases cured without altering the fluids :

In the Cullenian practice we find fevers remaining after the surface is relaxed, and the patient bathed in sweat; and in accounting for the proximate cause, an effect, a set of symptoms, are usurped for an agent. And in the Brunonian elements, elements drawn from the nutrition of vegetables, to account for irregular vital actions, we find a grosser absurdity; diseases attributed to excess of stimuli, where there are none added; and again, diseases attributed to debility, when stimulants augment them.— Under such circumstances as these, I think an attempt upon a subject of such importance should be pardoned, and examined by every candid physician and philosopher.

The AUTHOR.

P R E F A C E

A N

ORIGINAL ESSAY, &c.

AS the human body is the object of this essay, it will be necessary to lay that out in a manner suitable to the purpose: in doing this I shall not trouble the reader with systems of anatomy or physiology.

With respect to the substance of the body—

I. There are parts, which, from their solidity or fluidity, admit of only passive motion: as the bones, tendons, blood, &c.

II. There are parts, which, from being a mere congeries of particles, or from their fibres being very short, and running equally in every direction, or, when otherwise, being too dense, admit of only slight contraction or tension: as the brain, cutis, ligatures, &c.

III. There

III. There are parts that have long, supple, elastic fibres, running mostly parallel, that are not very compact or solid; by which they admit of considerable approximation; as the muscles in general.

This division respects the body clear of life and animation; the next respects it in a perfect state, in which these are super-added to the former:

IV. It may be considered as a common vegetable; having the same principle of union, and the degree of solidity depending upon the quantity of water in it, and the degree of heat afforded it; having a tendency to extend to an *acme*, bounded by increased resistance and desisting extension.

V. It may be considered as a moveable, vital body, capable of contraction, with relaxation, an effect, without the assistance of an animal power, *the will*, similar to what is observed in those extraordinary plants, vulgarly called sensitive; performed by the instrumentality of a vital principle, moved by various material powers.

VI. It may be considered as animate; having a soul diffused throughout it, which acts upon every suitable medium; and many parts are under the influence of the will, one of the animal powers, which, by the instrumentality of the vital principle, produces the intended effects, and not without it;

These have hitherto been greatly confounded

it; though these very parts, whose actions are obedient to the will, are liable to be excited contrary to the intention, and consequently without the assistance, of the will: but such motions are irregular. In some parts a combination of voluntary and involuntary motions takes place; however, the former constitute the ordinary, and the latter, the extraordinary motions. The parts that are required for motion, in the animal oconomy, are only capable of being acted upon, when furnished with a principle or element (as has been already mentioned) which yet awhile I shall term vital,* totally different from the animal principle, called the mind * or soul.

The actions of the different parts of the body, would be in proportion to the quantity of the vital element they are capable of containing, and the quantity transmitted to them, were they equally suitable; but they are not. The quantity a part is capable of containing may be termed its capacity; which I shall endeavour to ascertain.

As laxity always decapacitates a part for motion, although none of the stimulating powers be withdrawn, it is but fair to conclude, that a proper density, on one hand, capacitates a part for containing the vital element,

* These have hitherto been greatly confounded.

element, and, on the other hand, as parts which become hard and earthy, by parting with their moisture and softer particles, lose their irritability; a further conclusion may be made, that a softness and delicacy are necessary to complete the capacity.

Hence, the more compact and delicate, the greater the capacity.

But as the motion of parts depends upon their being condensed, it follows, that the more dense, the less capable: by this means many parts, that contain the most vital principle, have nothing more than a little tension or compactness produced in them: this is the case with the blood, brain, nerves, &c.

The quantity of vital principle determined to a part depends upon the quantity of stimulus it receives; and this depends not only upon the absolute quantity and degree of power in the stimulus, but also upon the capability of the part to receive a stimulus.

The more delicate parts are usually screened by the less delicate covering them; hence the more open, the nearer the application of any power may be made to the parts that contain most vital principle. From this it is plain (with what has been said) that parts capable of much action are capable of receiving much stimulus; and that openness or laxity capacitates a part to receive

ceive stimuli: and as motion exhausts the vital principle, those parts easiest put in motion, which are those of the most suppleness and delicacy, must be the most susceptible, and hence it follows, that delicacy and openness or laxity combined furnish the completest capacity for receiving the effect of stimuli.

These things being premised, and having therein considered the vital principle as the instrument of all animal motion, it now becomes necessary to define it.

DEFINITION.

A principle of attraction, which, when in intimate unity with any substance, produces and is the cause of its solidity, when passed through bodies in an insufficient quantity to alter their constitution (in which case it cannot enter into union) producing an active contraction of them, provided they are sufficiently flexible to yield to the force of attraction exerted, and their density do not forbid farther approximation.

Although this principle or element is opposite in effect to fire, yet it is very similar with respect to its states and laws of operation; and as I shall often call in the laws of the latter, they being more explored and evident,

evident, to elucidate the former, I wish that the similarity may be early attended to.

Thus then as one is the cause of fluidity, the other is the cause of solidity, and in these states both of them conceal many of their properties:

Both of them, in the above states of intimate unity, are capable of being separated from that state, the one by the other, and then they discover more of their properties; then passed thro' bodies under the circumstances mentioned in the definition, producing action; one contraction, the other repulsion.

Both pervading all bodies, and being the cause of their states of more or less solidity. These, with many other similarities, might be considered, but enough for the present.

I shall now go on to the discovering the source of this element; in doing which I must proceed *gradatim*, beginning where it is most evident, and tracking it to the fountain-head.

When we compare a state of life with death, we must conclude that in life there was a power which produced the characteristic thereof: and as all the visible parts remain in death, we must conclude that the power of life was some very subtle principle, and resided in those parts that remain.

The nerves that lead to a part capable of motion being cut, the motion of the part

is

is prevented, altho' all the material stimuli are applied in their proper quantity, and the intention and will are as free to act as ever. From this it is plain that it is the principle of attraction that is intercepted, and not the stimuli; and as the nerves have their prime origin in the brain, it follows that they conducted the principle of attraction from the brain to the parts of action. The next question is, From whence did the brain * receive it?

Whoever considers the circulation of the blood thro' the brain, doctor Hunter's arguments for a living principle in the blood, abbe Fontana's experiments with poisons applied to the blood, and the next gradation, cannot but answer the question by saying that some part of the brain separated it from the blood. The cerebellum, from the effect of an irritation upon it, appears to have a very full charge of it, and no doubt separates or receives that principle from the blood, and transmits it to the nerves. What particular parts, any more than what I have mentioned, are for the same purpose, I would not pretend to say, and all, if any, I cannot allow; for certainly there are particular organs there that serve for themselves, and not for others.

Let

* I do not suppose the brain to be a reservoir of this principle in any considerable degree, but rather a secretory.

Let us now see if the following facts can prove from whence the blood received it; for surely it was not generated there.

Without constantly receiving air into our lungs we cannot live: from this it is clear that we draw such elements therefrom that are sufficient for life; especially as the blood is mild, being composed of chyle, and in the course of a few minutes could not become so acrid as to kill unless ventilated; therefore it is not by imparting, but receiving something, that life is sustained by respiration. While respiration goes on, the blood obtains a temperature above the surrounding atmosphere; and the air of expiration, by Mr. Crawford's experiments, contains less absolute heat than before inspired: hence it is plain that heat is received by inspiration. But this alone will not support life, for if an animal be put in a bottle that has a given quantity of air, he will die in a short time after it has passed the office of respiration, altho' the bottle be kept to the temperature he requires; and life would always be restored in a recent case of suspended respiration, by applying sufficient heat, if that was the only suspended power. From this it is plain that something more than heat is derived from the air. Animals that have had respiration suspended for some time shew a loss of irritability,

tability, and if respiration has been suspended even twenty minutes; in a great number of cases (with men) all the artificial stimuli that could be applied would prove insufficient to excite the small remains of vital principle sufficient for the purposes of life.

From this again it is evident that more than heat, which is generally allowed to be a stimulus, is taken from the air. A loss of motion usually succeeds action without the loss of any stimuli, which must depend upon a loss of irritability, and of consequence the principle of irritability is exhaustible, and therefore must be supplied from some source; and where can we look for a source, but where concurring facts and reason point us?

Various plants shew us evident symptoms of life, as many of the animal organs, being subject to a diurnal contraction and nocturnal relaxation: and whence can they procure a vital principle or principle of motion, but from the atmosphere? Air shews not only an elasticity and circulum, which is a proof of its possessing a principle of repulsion, but also an elasticity and centrum, which must be an equal proof of its possessing a principle of attraction; this is evident in its immediately restoring itself as quick as expanding powers are withdrawn.

Finally,

Finally—The death of an animal from suspended respiration appears to be purely negative, and the few symptoms that accompany it are the effect of parts not equal or synchronous in action, not suffering equally from the beginning and synchronous, as might in reason be expected. From the consideration of these things I think it may be safely concluded that the principle of *irritability*, which is the principle of *life*, which is a principle of *attraction*, is separated from the air taken in by inspiration.

Nor does the circumstance of the air appearing more dense and compact after inspiration militate against its imparting a principle of attraction to the blood; for we must allow that the air possesses certain quantities (if we allow any) of these elements; suppose equal quantities: any power then that is capable of separating these, may separate unequal quantities. This appears to be the case with animals, particularly those of warm temperatures: they demand a larger portion of heat than of vital principle. Hence the spoliated air retains a larger proportion of attracting principle than when it was taken in. This is further proved by the method of renewing air: Vegetables and water require the assistance of the air to their continuing in a proper state;

state; it is evident they absorb some principle (besides heat) and if we allow this to be a principle of attraction, which, it is evident, plants require, for they are formed from fluid particles made solid by some means, we can easily see how they should renew air; for they render the proportions somewhat equal again; and similar to what we observe with respect to the opposite principle, the state may be changed, viz. the air may return with more in a loose state, and considerably less in an intimate state.

This is as far as I shall go in the positive; I shall now add a probable conjecture.

As the principle of repulsion, although plenteous in the atmosphere, has its prime source from the diurnal luminary, may not the moon be a source of the principle of attraction?

Is it not the power of attraction that she one while exerts on a part of the globe, and then in her journey relinquishes, that produces the tides? Is it not this power perpetually in double motion, menstrual and diurnal, together with a motion somewhat different of our earth towards and from a fountain of an opposite principle, that causes the different states of the weather? Finally, are not two such powers sufficient to produce motion? It is true that it will be somewhat difficult to conceive

ceive how these elements can be active, but they are so: and, as I suppose, in this way; the particles of fire, as well as the particles of the attractive element, have certain boundaries, the one in extent, the other in concentration; to each of these boundaries they would certainly arrive were they perfect, but they are not; being among bodies that variously affect them, and likewise being in constant opposition to each other. Hence they will (except when they so equally oppose each other in one body as to become quiescent) ever be aiming at their original boundaries; and hence they will ever produce action till they have arrived at that point, which they never can do amidst the different elements.

I am aware that by this time I have overrun two prevalent doctrines; permit me therefore to digress awhile to take these up.

The first is, that a certain modification of the nervous extremities is sufficient for the purposes of motion.

The second is, that a peculiar modification of the muscular fibre renders it susceptible of stimuli.

To these I may object,

1. That such a peculiarity is inconceivable.
2. That the nerves and muscular fibres are in complete symmetry after death, by drowning.

3. That tying of a nerve could not alter the modification of its extremities, nor the depending muscle.

4. That the nerves and muscles are nothing but gross, inactive matter of themselves.

It has been objected to every doctrine that held up for the transmission of a fluid through the nerves to the muscles, that the supposed fluid was invisible, and that the nerves were destitute of cavities. If such objections as these are allowed, we must disbelieve the existence of fire in the air, and the possibility of heat or the electric spark passing through a wire; because the same objection may be made to these. But for a further refutation and to put this matter beyond all doubt, I shall quote an experiment of Bellini, which was repeated with equal success by Dr. Monro. These are the doctor's words: "After opening the thorax of a living dog, catch hold of and press on both the phrenitic nerves with the fingers: the diaphragm ceases immediately to contract. Then let go the hold of the nerves, and the muscle acts again. Pinch a second time the nerve or nerves, some way above the diaphragm; this muscle again ceases to act. Keep firm hold of the nerve, and with the fingers of the other hand strip or milch
C " it

“ it down from the griping fingers towards
 “ the diaphragm, and the muscle is made
 “ to contract; and for three or four such
 “ strippings or milchings its action follows
 “ or obeys the motion of the fingers which
 “ strip it down: then it becomes disobedient,
 “ and contracts no more, milch as you
 “ will, unless the fingers griping or pinching
 “ the nerve let go their hold or are removed
 “ higher up upon the nerve, when the muscle
 “ may be made again to contract by stripping
 “ the nerve down towards it,” &c.

OF THE MODUS OPERANDI.

Upon the strictest examination, the action of any part of the system appears to consist in nothing but contraction and subsequent inactive relaxation, caused by the cessation of the power that produced contraction.

The only variation consists in the degree and time. As to the degree—I have before spoke of the causes thereof: with respect to the time—in those parts whose action the animal œconomy cannot dispense with for any time, the contraction is very short and violent, and the relaxation as short; but in these parts where action can be dispensed with for some time, the contraction lasts for hours, and the subsequent relaxation is

answerable

answerable thereto; or there is a compound of these two, as in the muscles obedient to volition, in which tho' the former motion takes place, yet it is unable to continue, and therefore comes under the class of the latter: the gentleness of the stimuli, and ready, equal supply of the vital principle, is the cause of so durable a contraction as what takes place in the latter.

As the vital principle is lodged in parts unsuitable to motion, and of itself passes but slowly to the different parts, it is clear that there would be no more than a trifling, steady, and unsuitable contraction of those parts where we discover very considerable action; unless there were some means of soliciting it or bringing it to these parts very rapidly; the means are, the provision of certain substantial, inanimate powers, for that purpose, in all the parts of involuntary action; and in the voluntary, the power of the will serves that purpose. These increase the afflux of the vital principle, which is followed by an increased contraction of the part to which it is brought. Therefore these powers go under the name of stimuli.

Stimuli act different ways to accomplish their end. Of two of their methods I shall speak in the subsequent examples; and of a third I shall proceed immediately to treat.

The

The effects of stimuli are much more obvious than the manner by which they produce their effect. The effect I have mentioned above: it is to cause an increased afflux of the vital principle, usually to the part to which the stimulus is applied. That this is all the action of stimuli, and that they are no ways conjunct, I think, may be readily concluded from distension proving a very effectual stimulus, which is a mechanical power and opposite to contraction. In treating of the manner I shall call in again the laws of an opposite power as an assistant, which, from its qualities, are more easily discovered and ascertained.

As solidity depends upon the quantity of the principle of attraction in intimate union, and fluidity upon the quantity of an opposite element, viz. fire, it follows, that all bodies, but those at the summit of solidity and fluidity, must possess both of these principles.

But it is observable, that besides that quantity of fire in bodies which constitutes their permanent state, there is a super quantity which does not enter into its composition so as to obscure the quality thereof, viz. heat. This produces what is called their temperature: with respect to this temperature—if two bodies of different temperatures (one of them being sufficiently high
to

to overbalance the effect of surrounding powers, or surrounding powers being excluded) be put together, the minus will absorb from the plus till an equilibrium be produced, and in proportion to the degree of the plus the minus will absorb more rapidly. This is one law. Again—different bodies will, at equal chances, receive and conduct heat more or less rapidly: thus, if pieces of different metals and of equal lengths and circumferences were placed in an equal degree of heat, at the end of one minute the heat of each would be found different, and the extent that the heat had penetrated would also be found different; the first would be ascertained by trying the degree of heat at the ends immersed in the fire, the last by the ends out of the fire.

Now, as nearly if not quite every body that we are acquainted with must possess both of these elements, viz. of attraction and repulsion, and as the above are the states and laws of one, it is probable that the other has similar states and laws; and the facts that every one must be acquainted with in the operation of those bodies we term medicine render it more than probable.

Thus then I suppose that there is what I shall term a temperature of attraction as well as repulsion around almost if not quite every

every substance; and this having like laws with the above, is the cause of their producing the effect we observe; and the manner is, that when one of those bodies is applied where there is a higher temperature,* there is immediately an effort to an equilibrium. This will appear more plain when we consider that living bodies have large quantities of attracting principle in them, which is in a very loose state and ready to be drawn off by any attracting or absorbing power; also, that the stimuli in the animal œconomy that act by their quality, are chiefly furnished by fluids that have been secreted from the blood; in which process it is probable that they have not carried that temperature * which the blood must necessarily be endued with, altho' they have become more dense. The reason of this supposition is; because they have been in some measure cut off from the source to which the blood is open; and in the slow circulation which they have undergone they must have imparted what they had no capacity to maintain nor means to supply.

Now when such a fluid is applied to a solid that has a higher temperature, the minus will begin to absorb from the plus; and this will increase the afflux thitherward, which will produce an increased contraction

of whole bodies the quiescent state of
 * Of attraction.

of the part, if it allows of contraction by the force applied.

With respect to the difference of action that the different stimuli produce, there are many reasons. The capacities of the different solids must furnish a great variety of temperatures. 2. Every part will have a different disposition to give out its temperature in a longer or shorter time. 3. The quantity of a minus applied. 4. The degree of power of absorbing that the minus possesses; and, 5. The time it may take to absorb. These, together with combinations of some of the above five causes, will be sufficient to account for the diversity of actions. The next thing to be considered is action itself: to elucidate which I shall give two examples as promised, one of involuntary, the other of voluntary motion; and if these can be made plain, I shall suppose that it will comprehend the chief circumstances that take place in the action of every other part of the system.

EXAMPLE I.

OF ARTERIAL MOTION OR ACTION.

The arteries are made up of three coats; one external, whose fibres run quaquaversum; a middle, muscular coat, whose fibres

fibres are circular, and well adapted to lessen the circle they form; and an internal smooth coat, very fine and dense, necessary to contain the blood with which it is filled. The nerves that supply the arteries are considerable; they run along the surface, and are lost in the external coat.

If we examine an artery, we shall find that it has a great deal of constituent elasticity both in restoring itself when the cavity is enlarged, and when the artery is extended in length. It is very probable, that the vital principle with which it is furnished does nothing more than to increase this property, only that the inherent power of elasticity is fixed, whereas I suppose the vital principle to be capable of change, as I shall endeavour to show hereafter. As the nerves are the conductors of the vital principle to the muscles and parts of action, there is little doubt but that every muscular fibre has a nervous fibre or spring attached to it; and as motion in other parts is a very effectual means to produce a supply of the principle of action, I may conclude that

* The fibres that run longitudinally are very inconsiderable compared with the circulars which are very observable; and for this reason: that the circulars have to contract one third if not more, and that with much force; whereas the others have much less force to exert, and not above one tenth perhaps to contract.

the action of the arteries, by perpetually straining and thus decapacitating the nerves that supply them, is the means of keeping up an afflux of this principle: it is also probable, as the muscular fibres have less of this principle than the nerves, that they exert an attraction for it or aim at an equilibrium, and thus perpetually draw it from the nerves.

If we examine the actions of the arteries, we shall find them perfectly correspond with their elastic capacities: thus, the arteries are passively enlarged and passively lengthened; but they are actively contracted and actively shortened.

As to the lengthening and shortening of the arteries, there has been little attention paid to it; but, upon a strict examination, it must be very considerable.

To prove this I may observe, that at each systole of the heart the arteries receive the full of the ventricles, and at each contraction of the arteries so much and no more is propelled into the veins; for if any more was propelled, the arteries would get empty. Upon a moderate calculation, the arteries contract one third of their size from the outlines of their extension: now, if they should discharge one third of their blood, instead of a few ounces a few pounds would be propelled into the veins.

What

What then becomes of the blood? The arteries were full in their utmost distension, and at their greatest contraction the blood remains no more condensed! Surely any person would answer, that the stream must be lengthened to compensate for the loss of circumference. As we cannot suppose the afflux of the vital principle to be equal to the degree and celerity of contraction we observe in the arteries, nor that it can be exhausted so quickly as we observe a relaxation to take place, I will venture to assert, that the action is aided by the movement of the principle of attraction from one coat of them to another: and thus the excess of action in one part is supported by a deficiency in the other: this is made plain by observing, that the artery is extended whilst it is contracted, that is, an active and passive state go together, and vice versa; whereas if it was a general effort which would be the effect of a general effusion into the artery, it would contract and attract or shorten at the same time. How this change of motion in the acting power is produced I shall now attempt to explain.

I may premise that nature, by giving the heart and arteries different nerves for supply, has taken care to provide against a synchronous action which would not answer.

Between

Between the limits of distension and contraction in the diameters of the arteries there is a neutral point which is of no duration: at this juncture the arteries are about half attracted, that is, they have shortened to about the point of their inherent spring; but they still rapidly attract themselves by the vital principle that has been effused into the fibres that run longitudinally.

At that particular point which I have been speaking of, the ventricles of the heart discharge their contents into the arteries, which mechanically distends them whilst they are shortening; as the arteries are always full, this addition must considerably affect them, especially as it must cause, beside the distension, a considerable motion of the blood already in the arteries; and this, together with a more effectual distension, proceeding from the column of blood being made shorter by the attraction or shortening of the arteries, would prove a very effectual distension to the circular fibres; each of which having a nerve, and these nerves, like other solids, being unable to retain the vital principle whilst thus agitated, would impart it to the contiguous *minus* fibres (only with greater readiness, as that is their office) and just about the time that the external coat had given up its *plus* to these

these fibres. By this addition and infusion of attracting principle the circular fibres would be considerably shortened so as to make the contraction of the artery, and at the same time lengthen the column of blood so as to make a passive extension. The effect of this would be, that the column of blood, being lessened in its diameter and quantity, would cease to distend, and the extension would distract every longitudinal fibre so as to bring about an effusion into them for their attraction; whilst the circulars would be giving back in turn their plus to the longitudinals: this would cause an effectual attraction of the artery, in doing which it would pass over the point I began at, where the blood was propelled by the heart into the arteries.

EXAMPLE II.

OF VOLUNTARY ACTION.

This is chiefly performed in the muscles of the extremities: with respect to the muscles it may be observed, that what is called the belly of the muscle is the most delicate and open part of it; the extremity or extremities being condensed into a more and more compact form as it or they advance to the place of insertion: also, that the muscles contain
a very

a very large portion of blood which distends them considerably, and that they are well supplied with nerves. By the constant distension and motion of the blood there is a constant supply of vital principle to the muscles, which keeps them in a state of ordinary contraction or readiness for extraordinary action; which is performed at pleasure in the following manner; the will, one of the animal powers, as I have supposed, is diffused throughout every part; in this diffused state it can only act slightly on the medium, viz. the parts of voluntary motion; and act none at all on parts that are not mediums. As it is an active power of self-exertion, we may suppose it to be of self-motion; therefore, whenever it is the intention, a collection or concentration to a sufficient quantity is made to the destined part; and the effect is answerable to the stimulus. This concentration or accumulation is pretty evident; because we cannot suppose any more acting power taken generally into the body at the time of the exertion than before; and because we are able to raise nearly as much with one side of our body as we can with both.

When by the means of the will exerting itself in the muscle, a larger quantity of nervous principle is discharged into it, the part most capable of contracting (which is the

the belly) will contract and draw the ends of the muscle towards each other, if they be not fixed; and the muscle will be upon the whole much condensed; * by which means a quantity of the blood will be forced out, and the muscle become more insensible † to what is left; and now if the will is not exerted more and more, the muscle begins to relax from want of ordinary stimulus (the distension of the blood) and wasting of the vital principle. But in general, the exertion of the will then ceases there and is applied to another muscle; this is usually called the antagonist; and as in many cases there is a communication, it is probable that the action of the antagonist is much aided by the vital principle of the other. This other then is in a perfect state of relaxation, at which time it is filled with blood again (the ordinary stimulus) and becomes ready for another action, which completes voluntary motion.

A SUMMARY.

* Perhaps a question might be asked, why the belly of the muscle swells under the exertion of an attracting principle? To this I answer, that, from the disposition of the muscular fibres, the attracting principle exerts its chief force in the direction of the fibres, and the muscles being always full of blood, the disposition of the blood will be altered so as to distend the sides of the muscle; which nevertheless becomes very hard and firm.

† See the paragraph on susceptibility.

A SUMMARY.

Upon the whole our doctrine chiefly consists in these particulars, viz.

I. That life is nothing but the principle of motion in animals.

II. That this principle is the sole agent of all our actions.

III. That, as all our actions consist in contractions, varying only in degree and duration, this principle must be a principle or element of attraction.

IV. That stimuli have no conjunct power in producing these actions, which may be proved various ways. 1. From their nature. 2. From distension proving a very effectual stimulus, in which there is no imparting of power, but an opposition to contraction; and this lasting after that is withdrawn.

V. That the effects of all stimuli are the same; which is, to bring the vital principle to the parts suited to action; and that they do it—by decapacitating the containing parts, the nerves; as distension—by being minus, and thus abstracting the principle of attraction towards them; like a cold body applied to a hot one; as epipastics, which have no action on dead bodies, &c.

VI. That

VI. That this principle of attraction is taken from the decomposed air, and received by the blood at the lungs, in the same manner and from the same cause as heat, viz. because the blood is minus.

VII. That it is separated from the blood by the brain; the cerebrum receiving such quantities as are necessary for the action of the mental faculties, to most of which it is a medium; and the cerebellum receiving the rest for the supplies of the body.

VIII. That this principle could produce no efforts in the blood, because the blood could not approximate; nor any more than tension in the nerves, because their form and slenderness would oblige this principle to pass in streams.

IX. That a principle of attraction is necessary and sufficient to preserve the body from putrefaction, as this consists in dissolution and the evolution of its principle of unity being extracted whilst there are no supplies.

X. That the faculties of the soul are not confined to the head, which there is no necessity to suppose, for the composition of a muscle or membrane is of the same origin as that of the brain, and therefore as fit for a medium; the tying of a nerve being no proof that the will is detached from the brain by that nerve, any more than it is a
proof

proof of sensation residing in the brain; for in both cases the vital principle, by the existence of which we discover all our faculties, is intercepted.

XI. That voluntary motion proceeds from the power of the will collecting itself to the part of action, which is a stimulus, we may prove from the action of other faculties effectually exhausting the vital principle, as well as by the effects we discover from the will itself.

XII. That the atmosphere being minus to the body must draw off this principle as it does the heat.

And, finally, that simplicity, easy conception, and numerous concurring proofs add greatly to the probability of this theory, which I now submit to the examination of the candid and sagacious, concluding that I have offered nothing but what seemed to me more probable than any thing beside, and what is the fruit of an impartial study.

F I N I S.

proof of function residing in the brain; for
the brain cells are vital and capable of the ex-
istence of which we have seen all our trials
are made.

XII. The brain is the seat of the intellect, and
the source of the will, and the seat of the
part of action which is a part of the will.
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part of action which is a part of the will.
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XIII. The brain is the seat of the intellect, and
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XV. The brain is the seat of the intellect, and
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